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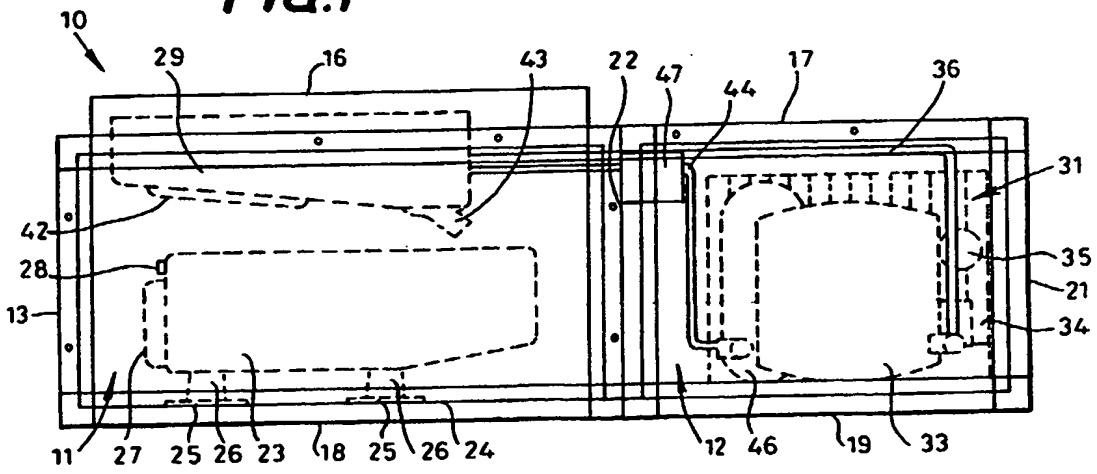
(54) Abstract Title
Refrigerated protective housing for optical projector

(57) A protective housing (10) for an optical projector (23), comprises walls defining first and second chambers (11,12). The first chamber (11) is substantially sealed from the ambient and has an internal mounting surface (24) for a projector (23). A wall of the first chamber (11) includes a projection window (13) through which a mounted projector (23) may direct light. The second chamber (12) substantially encloses a refrigeration unit (31), connected to a cooling element in casing (29) mounted in the first chamber (11). During operation of a projector (23) disposed in the first chamber (11), the temperature within the first chamber (11) may thus be maintained below a pre-set value.

FIG.1



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG.1

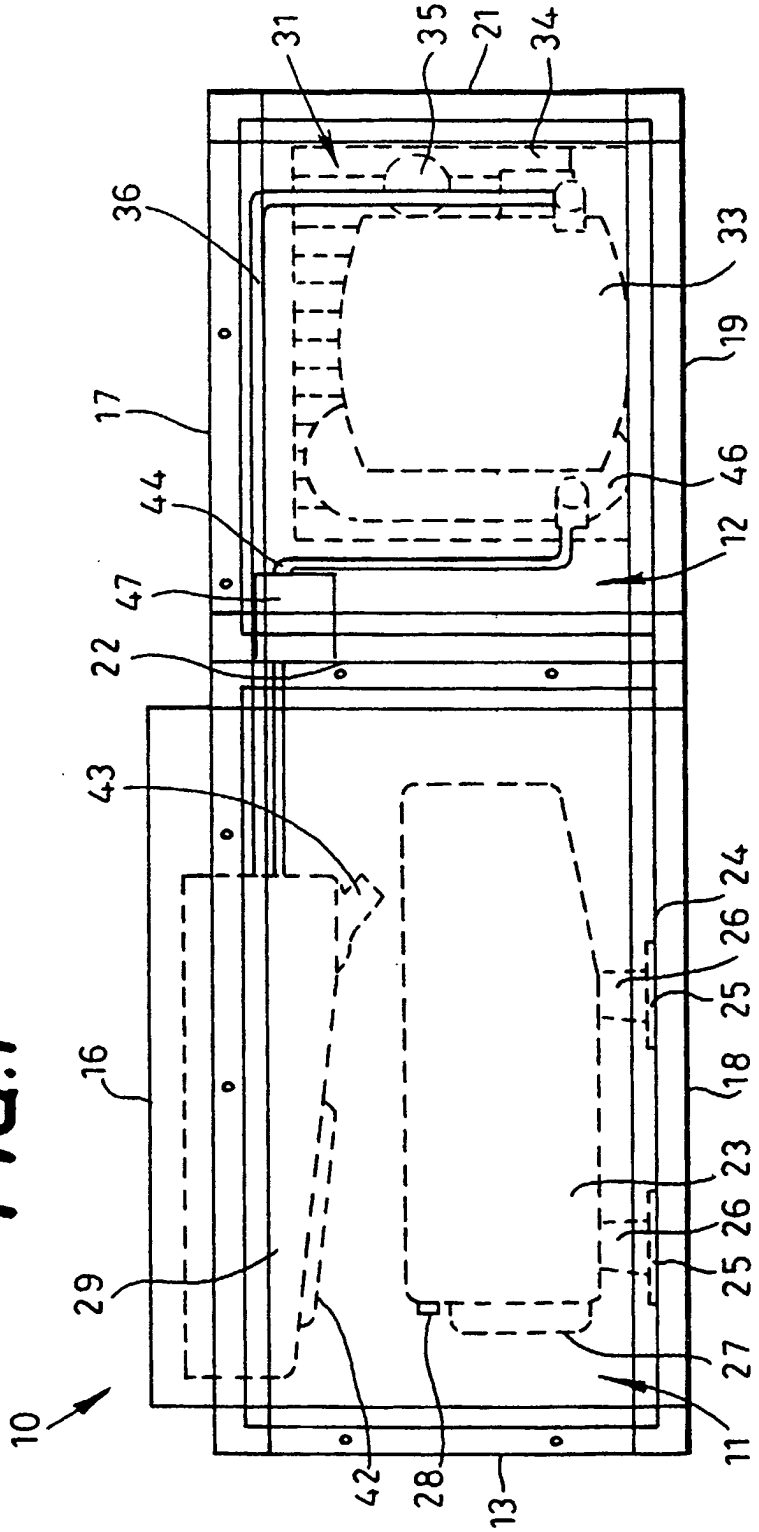


FIG.2

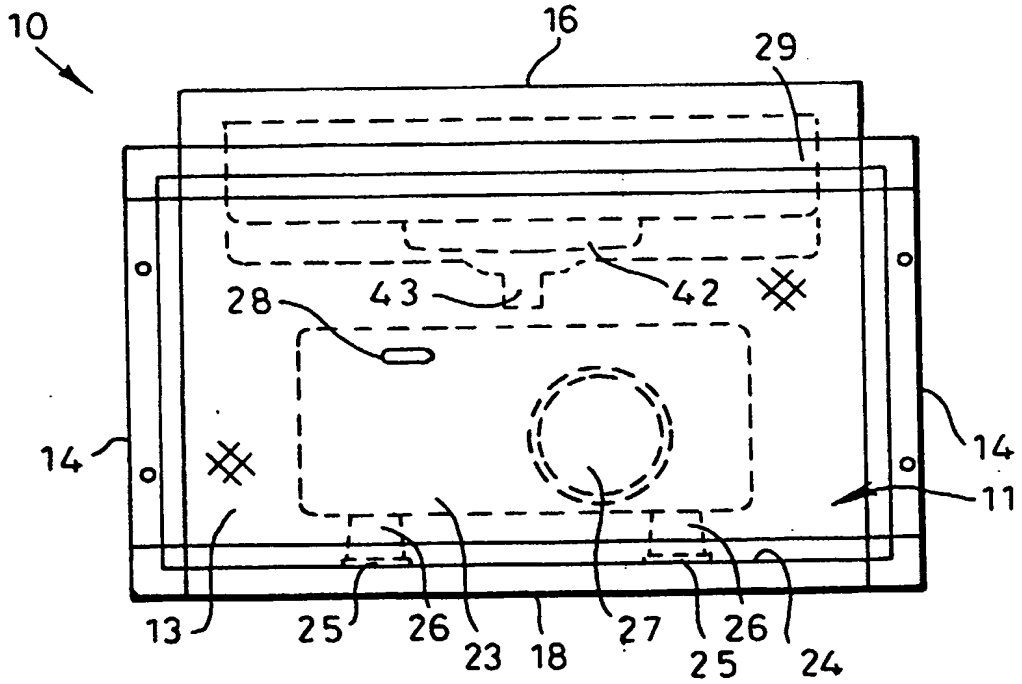
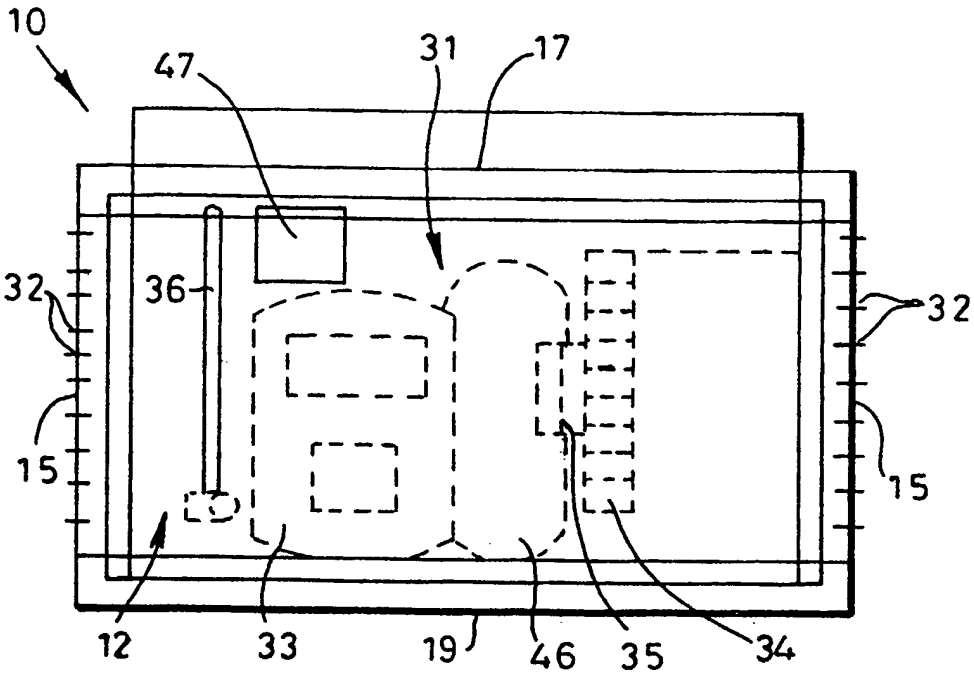


FIG.3



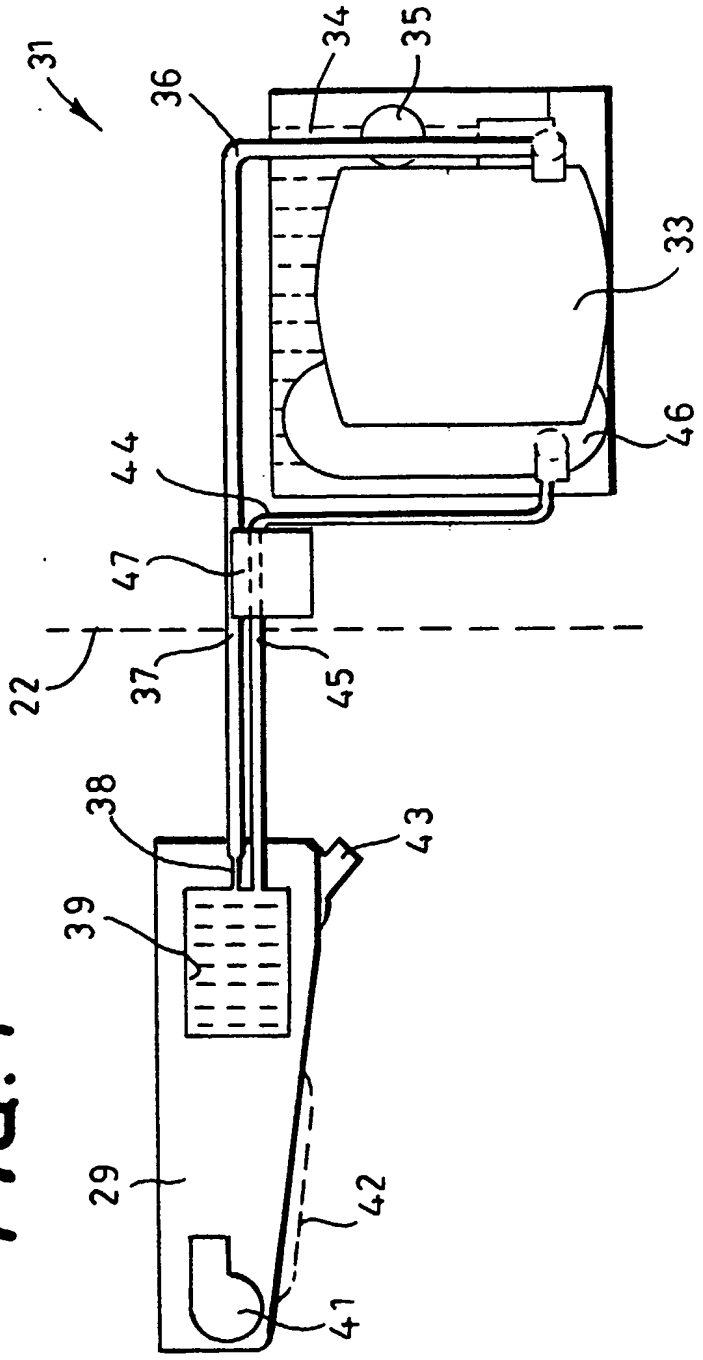


FIG.4

PROTECTIVE HOUSING FOR PROJECTORS

This invention relates to a protective housing for an optical projector. Whilst this invention may find application with all kinds of optical projection equipment, such as digital light processing (DLP) or image light amplifier (ILA) projectors, it is envisaged that its main use will be with liquid crystal display (LCD) projectors, and therefore the invention will be described below with particular reference to these.

Optical projectors have been used for many years for the presentation of recorded images, whether still or in motion, and there have been many developments in the associated technology. In particular, the development of LCD projectors has allowed the projection of brighter and more colourful images from digital sources than has previously been possible. This type of projector has found widespread use in *e.g.* lecture theatres, board rooms *etc.*

In recent years, particularly since the advent of satellite and so-called "pay-per-view" television, there has been a trend for sporting events and the like to be shown on large screens in public houses and bars. This is usually accomplished by means of a projection television system, and LCD projectors are particularly suitable for this purpose.

However, a LCD projector utilises a very bright source of white light, usually with a relatively high power rating. It is therefore necessary to provide constant cooling of the bulb and the optical lenses. In an environment such as a lecture theatre or board room, this can be achieved merely by the continuous pumped circulation of ambient air through the projector.

In a public house or bar environment however, the air is likely to be contaminated with airborne dirt and pollutants, in particular tobacco smoke, which can damage the optical systems and cause a loss of performance, and ultimately the failure of the projector. It has been found that projectors cannot easily be cleaned of such pollutants without the likelihood of causing further damage to the optical systems. Further, a projector mounted in a confined space such as a bar or public house, is likely to lead to an unacceptably high noise level.

Known systems for the cooling of projection systems tend to be concerned with the cooling of the internal optical components themselves, and are thus incorporated within the body of the projector. These systems therefore do not address the same problem as the present invention.

There is thus a need for a system which will allow a projector to be maintained at an acceptable temperature, and yet keep the projector components isolated from contaminated ambient air.

Therefore, according to the present invention there is provided a protective housing for an optical projector, which housing comprises walls defining first and second chambers, the first chamber being substantially sealed from the ambient and having an internal mounting surface for a projector, a wall of the first chamber including a window through which a mounted projector may direct light, and the second chamber substantially enclosing a refrigeration unit, there being a cooling element mounted in the first chamber and connected to the

refrigeration unit whereby during operation of a projector disposed in the first chamber, the temperature within the first chamber may be maintained below a pre-set value.

The walls of the housing defining the first and second chambers may be of any suitable construction so as to accommodate, respectively, a projector and a refrigeration unit. However, for ease of construction it is currently preferred that the housing should be of generally rectangular shape in cross-section, and should comprise a plurality of interconnected panels. These panels are hereinafter referred to as front, back, top, bottom, and side panels, with respect to the intended direction of light from a projector mounted within the first chamber.

The front panel of the first chamber may include, or be defined by, the projection window through which the image is to be projected. Control of the projector may also be managed *via* this projection window, by means of an infra-red remote control. In a currently preferred embodiment of the invention the front panel is a double-glazed window of clear glass. Any build-up of dirt or pollutants on the exterior surface of the projection window can easily be removed by standard glass cleaning products.

Preferably, a dividing panel is located internally within the housing to separate the first and second chambers. It is further preferred that the dividing panel should constitute both the back panel of the first chamber, and the front panel of the second chamber, such that the

second chamber is located immediately behind the first chamber, with respect to the intended direction of light from a projector mounted therein.

At least some of the panels defining the first chamber may be double-skinned so as to define a cavity within which is provided thermal insulation material. It is currently preferred that these panels comprise galvanised sheet steel skins, with mineral wool or expanded polystyrene being the preferred insulation material. The outer surfaces of the panels may be coated with a decorative plastics material.

In order that the projector and refrigeration unit may be accessed for maintenance, at least one panel of each chamber may be removably inter-connected to the adjoining panels. The removal of the panels may be achieved by releasing a locking mechanism using a suitable tool.

In a currently preferred embodiment of the invention, both side panels of the first chamber are removable in order to allow access to the projector, whilst the back panel of the second chamber is removable so as to allow access to the refrigeration unit. The side panels of the second chamber may be perforated or in the form of grilles so as to allow air flow therethrough, to exhaust heat from the refrigeration unit.

The substantial sealing of the first chamber is preferably achieved by providing a sealant at the joints between adjacent panels. In the case of the removable panels, the sealant may be a re-usable gasket, but for the joints between the fixed (*i.e.* non-removable) panels, a seal may be achieved by means of a silicone sealant material.

The refrigeration unit may be of an essentially conventional design, comprising a compressor, a heat exchanger, and a flow restrictor or expansion valve, the cooling element then being an evaporator coupled to the refrigeration unit. Such a system involves a continuously operating cycle of circulating a gaseous refrigerant by compression, and then condensing the refrigerant to a liquid in a heat exchanger, thus dissipating heat, before being passed to the evaporator where it is returned to its gaseous state, thus absorbing heat. As refrigeration cycles of this kind are well known, they will not be described in further detail here.

In the present invention the evaporator forms the cooling element, located within the first chamber, whilst the rest of the refrigeration system is located in the second chamber. The refrigerant is carried to and from the cooling element by means of refrigerant copper pipe passing through the dividing panel between the first and second chambers.

Preferably, the cooling element may include a casing within which the evaporator is located, there being a fan to circulate air through the casing, and over the evaporator. The casing may have air inlet and outlet vents, preferably located so that cool air is expelled directly over the part of the projector which in use requires the greatest cooling.

The refrigeration unit will preferably be controlled by means of a thermostat connected to the compressor, in order to ensure that the temperature within the first chamber remains below 40°C. More

preferably, the temperature will be kept at around 20°C.

The housing may be further provided with a bracket or other mounting arrangement by means of which the housing may be suitably supported on a wall, ceiling, or the like.

In order that the present invention may be fully understood, one preferred embodiment will now be described in greater detail, though only by way of example, with reference to the following drawings, in which :

Figure 1 is a cross-sectional side-view of a protective housing according to the invention;

Figure 2 is a cross-sectional view of the first chamber, taken from the front of the protective housing of Figure 1;

Figure 3 is a cross-sectional view of the second chamber taken from the rear of the protective housing of Figure 1; and

Figure 4 is a schematic representation of the refrigeration unit contained within the protective housing of Figure 1.

Referring to Figures 1 to 3, there is shown a protective housing, generally indicated 10, comprising a first chamber, generally indicated 11, and a second chamber, generally indicated 12. The housing 10, is defined by a plurality of interconnected panels comprising a front panel 13, side panels 14 and 15, top panels 16 and 17, bottom panels 18 and 19, and back panel 21. A dividing panel 22 separates the first and second chambers 11 and 12, thus forming both the back wall of the first chamber 11 and the front wall of the second chamber 12. In the

embodiment shown, the housing 10, and its constituent first and second chambers 11 and 12, are each generally rectangular in cross-section. The housing 10 may be provided with a bracket or other mounting arrangement (not shown) by means of which the housing 10 may be suitably supported on a wall, from a ceiling, or the like.

Referring now to Figures 1 and 2, the front panel 13 is in the form of a double-glazed toughened clear glass projection window for an optical projector 23, which is supported in the first chamber 11, on the internal surface 24 of bottom panel 18. The projector 23 is located in the required position by means of sockets 25 in which the legs 26 of the projector 23 are received.

The projector 23 is arranged such that its objective lens 27 directs light through the projection window 13. The projector 23 is also provided with a control system including an infra-red receiver 28, to permit the projector 23 to be operated by a remote control transmitter (not shown) which directs infra-red radiation through the projection window 13 to the infra-red receiver 28.

The panels 13, 14, 16, 18, and 22, which define the first chamber 11, are interconnected such that the first chamber 11 is substantially sealed from the ambient. This is preferably achieved by providing a sealant at the joints between adjacent panels. In the embodiment shown, the side panels 14 of the first chamber 11 are removable so as to allow access to the projector 23 for maintenance purposes. In the case of these removable panels 14, the sealant is a re-usable gasket,

whereas for the joints between the fixed panels 13, 16, 18, and 22, a seal is achieved by means of a silicone sealant material. The removable side panels 14 are secured in position by socket-headed screw operable by an Allen key.

In order to assist the maintaining of an approximately constant temperature in the first chamber during operation of the projector, the panels 14, 16, 18, and 22, defining the first chamber (other than the projection window panel 13) are double-skinned so as to form a cavity within which is provided thermal insulation material. These panels 14, 16, 18, and 22 comprise galvanised sheet steel skins, with mineral wool as the insulation material. The outer surfaces of the panels 14, 16, and 18, may be coated with a decorative plastics material.

Internally, the first chamber 11 is provided with a casing 29 for a cooling element, which will be described in more detail subsequently with reference to Figure 4. The casing 29 is mounted on the internal surface of the top panel 16, to be disposed above the projector 23.

Referring now to Figures 1 and 3, the second chamber 12 is defined by the dividing panel 22, side panels 15, top panel 17, bottom panel 19, and back panel 21. A refrigeration unit, generally indicated 31, is substantially enclosed within the second chamber 12. In this preferred embodiment, the side panels 15 are in the form of grilles 32 so as to allow air flow therethrough, to exhaust heat from the refrigeration unit 31. The back panel 21 is removable so as to allow access to the refrigeration unit 31.

Referring now to Figure 4, the refrigeration unit 31 comprises a compressor 33 which compresses gaseous refrigerant, causing an increase in heat, and supplies the thus-compressed gaseous refrigerant to a heat exchanger coil 34. Here the heat is dissipated to the ambient through the grilles 32 in the side panels 15 of the second chamber 12, with the aid of a fan 35. The refrigerant is condensed to a liquid and is then carried by a first conduit 36, which passes through a first sealed aperture 37 in the dividing panel 22, passing into the first chamber 11, and into the casing 29 mounted therein.

On entering the casing 29, the liquid refrigerant is forced through a flow restrictor or expansion valve 38, into a cooling element, in the form of an evaporator coil 39, where the refrigerant re-evaporates to a low-pressure gas, thus absorbing heat from the surrounding air.

A fan 41 is provided within the casing 29, and acts so as to circulate the air within the first chamber 11. Operation of the fan 41 causes warm air to be sucked into the casing through an air inlet vent 42, and then propels it over the evaporator 39, before expelling the thus-cooled air through an air outlet vent 43, which in use is positioned above the part of the projector 23 in which the light source is located.

The refrigerant exits the evaporator 39, and is carried by a second conduit 44 back through a second sealed aperture 45 in the dividing panel 22, thus passing back into the second chamber 12, where it passes into an accumulator 46, before being returned to the compressor 33, to repeat the cycle. A thermostat 47 is connected to the compressor

33, and to temperature sensor (not shown) located in the first chamber 11. By adjusting the thermostat 47, the operation of the refrigeration unit 31 may be controlled such that the operating temperature in the first chamber is maintained at around 20°C.

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CLAIMS

1. A protective housing for an optical projector, which housing comprises walls defining first and second chambers, the first chamber being substantially sealed from the ambient and having an internal mounting surface for a projector, a wall of the first chamber including a projection window through which a mounted projector may direct light, and the second chamber substantially enclosing a refrigeration unit, there being a cooling element mounted in the first chamber and connected to the refrigeration unit whereby during operation of a projector disposed in the first chamber, the temperature within the first chamber may be maintained below a pre-set value.

2. A protective housing as claimed in claim 1, which housing is generally rectangular in cross-section, and wherein the walls of said housing comprise a plurality of inter-connected panels.

3. A protective housing as claimed in claim 2, wherein at least some of the panels comprise a cavity substantially filled with an insulation material.

4. A protective housing as claimed in claim 3, wherein the insulation material is mineral wool.

5. A protective housing as claimed in any of claims 2 to 4, wherein the panels are formed substantially from galvanised sheet steel.

6. A protective housing as claimed in any of claims 2 to 5, wherein at least one panel of each chamber is removably inter-connected to the adjoining panels.

7. A protective housing as claimed in any of the preceding claims, wherein the projection window comprises double-glazed, toughened clear glass.

8. A protective housing as claimed in any of the preceding claims, wherein at least one wall of the second chamber is adapted to allow air flow therethrough, such that heat may be exhausted from the refrigeration unit.

9. A protective housing as claimed in claim 8, wherein the at least one wall of the second chamber adapted to allow air flow therethrough comprises grilles.

10. A protective housing as claimed in any of claims 2 to 9, wherein the joints between adjacent panels of the first chamber are provided with a sealant.

11. A protective housing as claimed in claim 10, wherein the sealant provided at joints between at least one removable panel and the adjacent panels is a re-usable gasket.

12. A protective housing as claimed in either of claims 10 or 11, wherein the sealant provided at joints between fixed panels comprises a silicone sealing material.

13. A protective housing as claimed in any of the preceding claims, wherein the refrigeration unit comprises a compressor, a heat exchanger, a flow restrictor and a cooling element.

14. A protective housing as claimed in claim 12, wherein the flow restrictor and the cooling element are located within a casing mounted

in the first chamber.

15. A protective housing as claimed in claim 14, wherein the casing further comprises a fan, and air inlet and outlet vents.

16. A protective housing as claimed in any of the preceding claims, wherein thermostatic control is provided to maintain the temperature within the first chamber below a pre-set value.

18. A protective housing as claimed in claim 1, and substantially as herein described with reference to the accompanying drawings.

20. A method of maintaining the operating temperature of an optical projector below a pre-set value, whilst substantially isolating it from the ambient, comprising mounting said projector within a protective housing as claimed in any of the preceding claims, and operating the refrigeration unit to extract heat from the first chamber during operation of the projector.

21. A method as claimed in claim 20, wherein the temperature in the first chamber is maintained below 40°C.

22. A method as claimed in claim 21, wherein the temperature in the first chamber is maintained at around 20°C.

Application No: GB 0028555.1
Claims searched: 1-22

Examiner: Chris Ross
Date of search: 28 February 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): G2J(J41)

Int Cl (Ed.7): G03B

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0767398 A1	(HES) the Figs	1, 20 at least
"	US 2837965 A	(GOLDSMITH) part 32	"
"	WO 98/49598 A1	(SEUFERT) abstract	"

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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